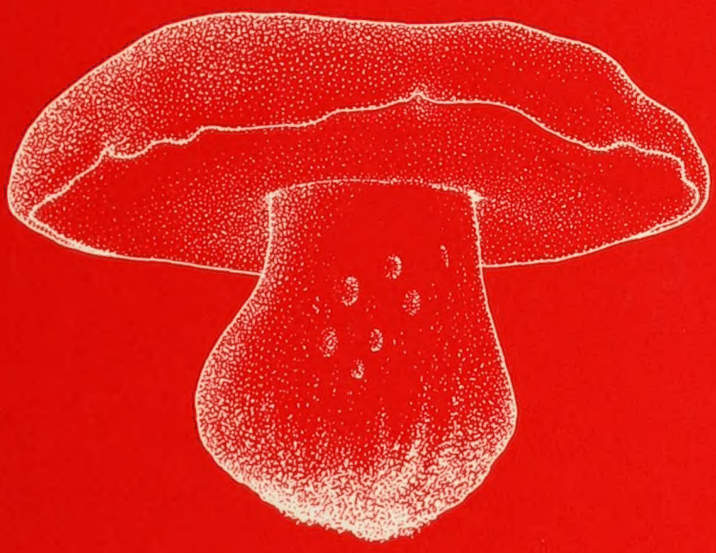
R. Walleyn & J. Rammeloo

The poisonous and useful fungi of Africa south of the Sahara



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The poisonous and useful fungi of Africa south of the Sahara:

a literature survey

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Cover illustration: O. Van De Kerckhove: *Phlebopus sudanicus* (redrawn from Heinemann & Rammeloo, 1980)

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INTRODUCTION

The present and our earlier literature review (126) give the compiled literature data on the toxicity, the edibility and miscellaneous uses by indigenous peoples, of the macrofungi of Africa south of the Sahara. The information given is considered only as a first step towards a better knowledge of poisonous African species and African ethnomycology but several conclusions and recommendations for future research can already be made:

1. The literature of the macrofungi of Africa south of the Sahara is very dispersed and often old. There is a great need to compile the complete bibliography of African mushrooms.

2. Recently published papers reveal that both taxonomic and ethnobotanical interest in the macrofungi of tropical and southern Africa is significantly growing. However, the great lack of complete monographs and floras, a critical check-list and the scarcity of ecological data still inhibit a more developed use of the indigenous mushrooms. For instance, some of the most important genera, both botanic and economic, are in an urgent need of revision (*Amanita*, *Lactarius*, *Marasmius*, *Lepiota*, etc.).

3. Until now, ethnomycological data are rather scarce due to the fact that the information is almost completely gathered by European mycologists which have less access to the primary source of information, the local people.

4. In many parts of Africa macrofungi play an important role during particular seasons in the diet of the local (rural) people which seem to have a great traditional knowledge of the edible species. In contrast, our scientific knowledge of the consumed species is far from complete; still many edible species remain undescribed or have been misidentified.

5. The use of mushrooms, esp. polypores, in traditional medicine seems not to be widespread or is at least poorly documented. Furthermore, this use often seems to be closely linked with mythological practices or beliefs.

6. Finally, our knowledge of the poisonous mushrooms of Africa south of the Sahara is almost restricted to some well described case histories in medical journals and the results of some laboratory experiments with animals. The toxic factor of most poisonous or suspected species remains to be clarified.

1 POISONOUS FUNGI

1.1 Introduction

A poor knowledge of African poisonous mushrooms

In general, the poisonous mushrooms of Europe and North America and their toxic substances are well-known and extensively documented (e.g. 7, 20, 132, 133). In contrast, the basic knowledge of all fungi of tropical and southern Africa is relatively poor and their study has advanced rather slowly. More new fungal species are described annually from the well-explored European continent than from Africa, due mainly to a lack of well-trained local mycologists.

However, at the present time the interest in African macrofungi is increasing significantly. Recent studies are concentrating on taxonomy, ectomycorrhizas or the cultivation practices of edible fungi. Ethnomycological studies remain scarce and focus on edible fungi. The knowledge of poisonous mushrooms is still fragmentary. Nevertheless, it is clear from the available literature that problems with mushroom poisonings in Africa do exist and that the toxic factor of several species remains to be clarified. Hence, many species can be labelled only as "suspect," without further information.

The need is great for a multidisciplinary approach by taxonomists, biochemists, medical practitioners, ethnobotanists, etc., of both the poisonous and the edible fungi of Africa in order to clarify the toxicity and taxonomic problems associated with certain species such as *Chlorophyllum molybdites*, *Amanita bingensis* and many others. In any event, it is useful to document incidents of poisoning, to collect the causative fungi and send them to specialists for proper identification (27). Since the basis of a detailed study has to be the investigation of incidents of poisoning as they occur, effective communication between victims, medical personnel and mycologists is essential (120).

A lack of basic documentation

As already has been stated for the edible fungi (126), the general lack of complete monographic treatments and critical mycofloras for tropical and southern Africa makes the determination of the indigenous macrofungi very difficult. Collections of these fungi were often named using European and other floras (e.g. 87). In addition, doctors and physicians confronted with mushroom poisonings are not generally knowledgeable about mycology, while a user-friendly guide to poisonous African mushrooms and advice on the treatment of such poisonings is far from realised. This explains, why with the exception of *Chlorophyllum molybdites* and some well-known *Amanita* species, the fungi responsible for almost every recorded incident have not been reliably identified.

During our quest through the very dispersed literature, references on poisonous macrofungi have been found from:

Tropics (165);
Equatorial Africa (69);
West Africa (94):
- Ghana (56, 77);
- Guinea (59);
- Ivory Coast (63);
- Nigeria (1, 4, 103, 104, 107, 166, 167);

Central Africa:
- Burundi (73);
- Cameroon (75, 76);
- Central African Republic (62, 63, 64, 66, 67);
- Zaire (12, 70, 71, 73, 124, 156);

East Africa (160):
- Kenya (22, 23, 28, 117);
- Malawi (27, 33, 91, 93, 94);
- Tanzania (99);
- Zambia (45, 116, 119, 120, 122, 153, 154);

Madagascar (16, 17, 18, 19, 55, 59, 65, 69, 127, 128, 131, 164); Mauritius (111, 112, 113);
Southern Africa:
- South Africa (13, 33, 37, 46, 82, 83, 84, 86, 90, 109, 129, 130 (Ciskei), 135, 136, 143, 146, 148, 149, 150, 158, 159, 163);
- Zimbabwe (39, 43, 53, 85, 88, 141).

In this review we have included information about macrofungi found to be poisonous to domestic animals but have excluded reference to poisonous microfungi (food contaminators) and lichens.

1.2 The traditional knowledge of poisonous mushrooms

In general, African peoples consume considerable quantities of wild mushrooms. Relying on the practices of their forefathers, they can reliably recognise selected edible species. In many regions mushroom poisoning seems to happen only rarely (e.g. 95, 156, 162), although poisonous species occur fairly commonly. In other regions, comparatively few cases of mushroom poisoning occur because mushrooms are avoided as an article of diet by populations who lack the confidence to recognise the edible ones and it is through such prudent fear of poisoning that mushrooms are only rarely used as a source of food [e.g. regions in South Africa (33), Lesotho (47), Madagascar (55)]. Some Nigerians claim that mushrooms give them stomach pains, while others are put off by the fact that maggots are found among the gills (103). In addition, Nigerians with the family name "Olu" (mushroom) do not experience mushroom poisoning as they have an aversion to the

association of their name with putrefaction and decay and consequently avoid eating mushrooms (103). Alibert (6) observed that, in Benin, fungi were never offered to the fetish because they feared the consumption of such food would offend the spirits that protect their houses.

Nevertheless, mushroom poisoning do occur, which is proved by case histories reported from Kenya (22, 28), Madagascar (55, 131), Malawi (91), Nigeria (100, 107), South Africa (33, 86, 143, 148, 149, 150, 163), Zambia (45) and Zimbabwe (88, 153, 154). Similar reports have also appeared in local newspapers (e.g. the *East Africa Standard* (1957); the *Daily times of Nigeria* (28 June 1963; 16 October 1967; 1 July 1970); the *Weakly star of Monday* (25 July 1977) which indicate that mushroom poisoning has "considerable morbidity and substantial mortality" (45). Mushroom poisonings seems to occur when

- children are left alone at home and prepare mushrooms they have collected (49, 52);
- inexperienced collectors pick up mushrooms for themselves (120, 162);
- species that are usually rejected are eaten during periods of famine (49, 52);
- some exotic, extremely poisonous species that have been introduced with forest plantations of *Pinus*, *Eucalyptus*, *Populus* or *Quercus*, are mistaken for indigenous, edible species (89);
- mushrooms are consumed that are contaminated by pesticides (100);
- personal allergies to "edible" species is manifested.

Piearce (118) gave ten points to bear in mind in order to avoid mushrooms poisoning and reminds the Zambians of the Tonga proverb "Sibbuzya takolwi bowa" meaning "the one who asks is the one who does not get poisoned by mushrooms," in other words "rely on experienced mushroom hunters."

As was once widespread in Europe, some traditional rules-of-thumbs are applied in order to distinguish the noxious from the edible species. In Nigeria, doubtful mushrooms are first fed to fowl and/or other animals (esp. chickens): if refused by the animals, the mushrooms are assumed to be toxic (1); if the mushrooms are swallowed, then they are considered to be edible; if consumed and subsequently vomited, then the fungus is considered to be edible with caution (100). The European fables that a mushroom is toxic when slugs refuse it or when it blackens a silver spoon, were also believed by immigrants to South Africa (148). Unfortunately, none of these methods are trustworthy and, out of sheer ignorance, many deaths have consequently occurred.

Moreover, several species or groups of fungi are mistakenly regarded as poisonous by local peoples. Zulus claim that all edible mushrooms contain a poisonous principle when uncooked (41). *Podaxis* is considered toxic by the Nupes of Nigeria (4). In the same country, the Yoruba people are of the

opinion that any fungus growing on a living tree is poisonous and that all stinkhorns are toxic (103, 104). Phalloid fungi also have a bad reputation with the Annamites (Madagascar, 55) who consider that all mushrooms which grow in association with buffalo excrements are edible but those that grow on or near horse excrement are poisonous. Furthermore, they regard violaceous capped bolets with great suspicion. *Phlebopus* species are regarded as very poisonous by the Betsimisaraka (17). In general, the bolets are completely overlooked in many regions of tropical Africa where they are mistakenly all thought to be poisonous (119, 156). In Zambia a rule-of-thumb advises that agarics having gills which are not concolorous with the cap should be avoided (119), thus excluding *Agaricus* species, which are consequently very seldom sought after by the local populations of tropical and southern Africa.

It is sometimes difficult to understand why certain species are not consumed. The traditional knowledge of local populations has contributed little as to wether some of the unconsumed species are poisonous or not.

Vernacular names

Most edible species have a proper vernacular name while poisonous and other unedible fungi receive less folk taxonomical attention (e.g. 91, 96, 156). A lack of interest in the use of fungi for food by certain populations is often found, together with a restricted vernacular naming of the indigenous mushrooms. Vernacular names often reflect the suspicion or fear the ordinary man has of mushrooms; see e.g. the vernacular names in Afrikaans for *Amanita phalloides* ("Duiwelsbrood" = devil's bread); *Podaxis pistillaris* ("Slangkop" = snake head) and the phalloid fungi ("Stinkhorings" = stinkhorns) (46). In Gabon (162) several species which are regarded as poisonous have also received some "unpalatable" names like "Ndagu ngongulu" (centipede's hole), "Gisumbi gi ndzigu" (scabby rumps of the chimpanzee) and "Gnaka-abongo" (pygmies' excrement).

Sometimes vernacular names contain valuable information. In Malawi "Bowa" is applied to edible fungi while "Chirombo" is used for the inedible species (91, 96). In Nigeria the name "Ajeimutin" (eat without drinking alcohol) was given to *Coprinus africanus* (103). The Lissongos of the Central African Republic, who use an extensive vernacular nomenclature for the naming of fungi, have also discovered the toxic properties of some *Coprinus* species: *C. erethistes* is named "Tongomokolo," the mushroom that is turning head and heart when palm wine is drunk (62, 63). Heim indicates that of the three species they call "Mosso kodo" (mushroom that kills the world) at least one seems indeed to be deadly poisonous (62-64).

1.3 Classification according to types of poisoning

As the knowledge of the poisonous African mushrooms is so very poor, incidence of poisoning can seldom be related to the causative agent(s).

In the category of the amanitoxin and phallotoxin intoxications, *Amanita phalloides* is a well-known representative. *Amanita capensis* almost certainly represents a colour variation of *A. phalloides* that provokes the same symptoms and it fits perfectly into this category. Most probably, an unidentified Nigerian *Amanita* spec. that has been shown to contain amatoxins (107) can also be classified in this group.

The most representative member of the fungi provoking monomethylhydrazine (gyromitrin) poisoning is *Gyromitra esculenta* and this species is known to occur in South Africa.

Coprinus africanus and *C. erethistes* fit well in the category of the coprine (antabuse-like) poisoning type.

In the category of the ibotenic acid and muscimol poisoning type, only the most well-known representatives, *Amanita muscaria* and *A. pantherina*, can be designed as African members of this group as they have been introduced in Africa with exotic forest plantations.

The large category of the gastrointestinal irritants contains some well-known fungi like *Chlorophyllym molybdites*, *Leucoagaricus badhamii*, *Omphalotus* and *Agaricus xanthodermus*; with certainty some African *Inocybe* and *Clitocybe* species will also fit here. According to Heim, *Clitocybe venenata* and possibly *Clitopilus octaristus* and *Lepiota cylindrospora* also belong in this category and may contain muscarine compounds.

Finally, there are several species that are known to be more or less toxic when eaten raw, cause poisoning symptoms that are of the same type: *Amanita vaginata*, *Boletus affinis*, *Phlebopus* species, *Pulveroboletus aberrans*, *Tricholoma mauritianum*, *T. spectabilis*, some Russulaceae.

Hallucinogenic mushrooms

Hallucinogenic or psychotropic fungi belong in a very special category of poisonous mushrooms (**psilocin** and **psilocybin** intoxications) (Singer in 133). If dosages within the tolerance of the individual human consumer are maintained, they are not necessarily poisonous in the dictionary sense of the word. Few of the thousands users of *Psilocybe* mushrooms find its poisoning effects, noticeable as abnormal functioning of the brain, anything but fascinating (133). However, hallucinogenic mushrooms may turn out to be poisonous or even fatal as a result of an overdose or from the combined effect of the psychotropic and other poisonous substances present in the fungus tissue.

We stated earlier that the use of fungi for their psychotropic effects seems to be very exceptional in Africa or at least is not well documented in the literature (126).

The fascinating 10,000 years old rock-drawings discovered in the Sahara desert (42) clearly indicate that the use of hallucinogenic mushrooms had existed in ancient times, but this case falls just out of our studied area.

More recently, Livingstones notes indicate of the use of green mushrooms called "Chisimba" where he hints at a mild psychoactive response, but this was perhaps more attributable to his yearning for a good roast beef (121). According to Piearce, these green mushrooms probably refer to a *Russula* species.

The experienced mycologist Heim (55) only noted that hallucinogenic mushrooms that cause a state of drunkenness ("ivresse gaie") occur in Madagascar and that a wood saprophyte called "Tsigegy" by the Tanalas is most probably one of them.

Thoen & al. (156) could not trace any use of psychotropic mushrooms in Shaba (Zaire) and concluded that this practice must be non-existent or accidental in this region; Härkönen & al. (52) gained no information in Tanzania about the use of fungi as hallucinogens.

Recently, an agaric resembling *Chlorophyllum molybdites*, called "A jegba'ariwo-orun" (eat and hear voices from heaven) by the Yoruba people of Nigeria, was used in an animal experiment (1). Rats fed on a diet where the mushroom supplied 10% of their total protein intake showed aggressive behaviour and extremely wild movements which could be explained by the presence of hallucinogenic substances (1).

Finally, some accidental poisoning cases by hallucinogenic mushrooms are reported from Kenya (22, 23, 28); at least *Psilocybe merdaria* was involved in these (115).

1.4 Experimental evidence for poisonous macrofungi

One way to investigate the toxicity of presumed poisonous mushrooms is to feed them to mammals. However, various kinds of animals are affected in different ways by the poisonous principles (e.g. dogs are more sensitive to *Omphalotus olearius* than men); therefore, such tests should be carried out only by experienced scientists and not by the mycophageous amateur.

Bouriquet was probably the first to test the toxicity of African mushrooms on mammals. In some experiments with dogs, two Madagascan *Amanita* species were concluded to be highly poisonous (16).

Sapeika & al. (135) extensively investigated *"Amanita capensis"* (regarded as a colour variant of *A. phalloides*) for toxicity; histological changes and effect on ascorbic acid concentration were studied in rats, and toxicity and serum transaminase levels in rabbits.

The effects of a toxic protein present in Madagascan specimens of *Boletus affinis* have been observed on mice (127).

Steyn & Talbot (150) investigated the toxicity of *Lepista caffrorum* by feeding it to rabbits and Sapeika & Stephens (135) used mice, rats, rabbits, guinea pigs and frogs for the toxic effects of *Clitocybe toxica*.

Recently, Adewusi & al. (1) used mice to examine the toxic and teratogenic properties of some edible Nigerian mushrooms. Their experiments revealed some valuable data which support the need for this kind of research.

Another way to investigate the toxic factor of mushrooms is to screen them for known toxic compounds. However, it is certain that many toxic substances remain to be identified. Chemical investigations of poisonous or suspected African macrofungi also appear to be very scarce and are mostly restricted to the control of a suspected qualitative presence of a known group of toxins. We know of only four chemical analyses concerning sub-saharan African mushrooms:

- the presence of "atropine" in South African *Amanita pantherina* and *A. muscaria* was shown by Lewis (83);
- qualitative analyses of *Tricholoma mauritianum* indicated the possible presence of cyanide responsible for the toxic factor in this mushrooms when eaten raw (113);
- amatoxins were detected in an unnamed, deadly poisonous Nigerian *Amanita* species (107);
- finally, the toxic protein bolaffinnine of *Boletus affinis* was purified and characterised by Razanamparany & al. (127).

1.5 Species reported to be poisonous or suspect

Presentation of the data

Our systematic review of the literature is presented the same way as for the edible fungi (126).

Nomenclature: All the scientific names used for poisonous or suspect fungi of Africa south of the Sahara which could be traced in the literature are listed here. They have been arranged in alphabetical order. However, references on toxicity alone are enumerated under the currently accepted names; synonyms are included and are cross-referenced to currently accepted names. In most cases the author citations were either lacking or did not follow the rules of botanical nomenclature. Author names have been added here, even when omitted in the original publication, and have been abbreviated following the recent recommendations for the standardising of authors of plant names [see Brummitt & Powell (1992) – Authors of plant names (Kew); Authors of fungal names, Index of Fungi 1992, Suppl. (IMC)].

References: In some cases it has been impossible to trace original publications cited in other papers. They may eventually contain more data on poisonous fungi.
The countries referred to are given in alphabetical order.

Comment: As a comment, further detailed information is given. When no comment is made, the species was mentioned in the original publication as poisonous, without further precision.

Agaricus

Agaricus aurantioviolaceus R. Heim — Equatorial Africa (69), Central African Republic (62, 63, 66).
Poisonous (62, 63, 66), with the reputation to be deadly (69). In contrast to some other toxic species it has no vernacular name in the Lissongo language. It belongs to the section *Sanguinolenti*.

Agaricus semotus Fr. — South Africa (82).
Poisonous to some: best avoided (82).

Agaricus xanthodermus Genev. — South Africa (46, 148, 158, 163).
Grows in groups under various tree species in the South Western Cape Province during May and June; under trees e.g. *Acacia* species in the Transvaal during March, April.
Poisonous (46, 148, 163), causing nausea, vomiting, indigestion, headache, profuse sweating and diarrhoea 2-4 hours after eating (158).

Agaricus xanthodermus var. ***lepiotioides*** Maire — South Africa (82, 163)
Poisonous to some: not recommended (82).

Agaricus xanthodermus var. ***meleagroides*** A. Pearson — South Africa (82, 109, 148, 163).
Poisonous to some: not recommended as an edible species (82, 109), the European and American varieties being poisonous to some people (109).

Amanita

Härkönen (49) stated that no poisonous *Amanita* species are known to be indigenous to tropical Africa but that some species introduced with exotic trees open the frightening possibility of misidentifying very poisonous fly agarics as one of the edible species. The literature shows that considerable problems with introduced poisonous amanitas exist. However, tropical Africa itself harbours several poisonous species that are as yet little known. In general the taxonomic knowledge of *Amanita* of tropical Africa is in urgent need of a revision. A useful revision of the South African species is recently published by Reid et al. (37, 129) but contains very little information about the toxicity of the indigenous species. At the present time, only the knowledge about the toxicity of the introduced species in our studied area

(*Amanita phalloides*, *A. pantherina* and *A. muscaria*) is well documented in the literature.

Amanita spec. – Madagascar (164), Nigeria (107).
The Nigerian newspaper *Weekly Star of Monday* reported on the 25 July 1977, that at least 12 lives were lost in several mushroom poisoning cases from Imo State. Chromatographic analysis of the fruitbodies revealed the presence of amatoxins (107). The characteristics of the basidiomes suggested that an *Amanita* species of the section *Phalloideae* was involved. In Madagascar a coprophilous "*Amanita* species" called "Olafainomby" is said by the local populations to be very poisonous (164).

Amanita alliiodora Pat. – Madagascar (69, 164).
Strongly suspect (164), and considered to be poisonous by the indigenous populations (44). Described by Patouillard as "closely related to *A. phalloides*" (108). Moreover, it has a characteristic flavour of onion, just like another *Amanita* species which is considered to be poisonous in Sudan (69). This led Heim (69) to consider it very likely to be poisonous.

Amanita baccata (Fr.) Gillet – Zambia (120).
Highly suspect.

Amanita bingensis (Beeli) R. Heim – Guinea (59).
Occurring in tropical Africa, not yet found in Cameroon (59).
Described by Heim because of its supposed high toxicity (59). According to the local people of northern Guinea, it causes serious intoxication which sometimes proves fatal (59). Apparently containing toxic alkaloids (144).
According to Singer (144), probably related to *A. tainaomby*. Morris considers it as a member of an *edible* group of yellowish *Amanita* species of Malawi (93). This is a clear example of the completely insufficient taxonomic understanding of the genus in tropical Africa.

Amanita capensis A. Pearson & Stephens nomen illegit. – South Africa (33, 129, 136, 148, 149, 163).
Not validly published and, in the absence of a type specimen, there is doubt as to whether this represents a distinct species (33, 82). It very probably represents an extreme colour variation of *Amanita phalloides* (82, 129) as it causes the same type of deadly poisoning symptoms (149).
In one reported case, four people developed poisoning symptoms about ten hours after eating this mushrooms, which they had mistaken for *Agaricus* (148). Three recovered after up to 15 days of suffering and the fourth died on the fifteenth day. In some other cases reported by Sapeika et al. (136), eight persons were involved of whom one died. The same authors investigated the toxicity of this fungus with experiments on rats and rabbits.

Amanita citrina (Schaeff.) Pers. – South Africa (129, 163).
Poisonous (163). In northern temperate regions considered as a gastrointestinal irritant only when eaten raw (20, 132).
Reid & Eicker (129) examined the only known specimen collected from South Africa and redetermined it as *A. pantherina*. It would seem that *A. citrina* has yet to reliably recorded from South Africa.

Amanita excelsa (Fr.) Bertol. – South Africa (129).
Edible when cooked but poisonous in the raw state; best avoided in the view of the strong risk of confusion with *Amanita pantherina*.

Amanita hovae Bouriquet – Madagascar (18, 164).
Possibly edible (18), but suspect (18, 164).

Amanita mappa = ***Amanita citrina***

Amanita muscaria (L.) Pers. – Malawi (33, 91, 93), South Africa (33, 46, 83, 84, 129, 148, 158, 163).
Poisonous (46, 83, 148, 158, 163) and hallucinogenic (33, 129). Usually not fatal, but causing nausea, vomiting, giddiness, hallucinations and even loss of consciousness 1-3 hours after eating (158). Widespread in South Africa, growing under pines and occasionally oaks, especially after heavy rain in spring and autumn, occurring singly or in groups (33, 129, 158). The vivid colouring of this species acts as a danger signal and (at least until 1950) it has not known in South Africa with certainty to have caused poisoning.
In Malawi it occurs frequently in all pine, bluegum and cypress plantations since it is symbiotic with the roots of trees (15). In its yellow phase, it could be confused with *Amanita bingensis* (ss. Morris !), but most Malawian women do not confuse it, and it is invariably referred to as "Chikoko" ("weed") (93). Nevertheless, Morris (91) reported one case of poisoning which concerned a group of forestry workmen who had to be transmitted to Zomba hospital after eating fungi from a *Pinus* plantation. Possibly some fruit bodies of *A. muscaria*, which is common on the plateau, has been mistaken for the "edible, bright yellow *A. bingensis*" (91).

Amanita pantherina (DC.: Fr.) Krombh. – South Africa (33, 46, 82, 84, 143, 148, 158, 163), Zimbabwe (39, 43, 53).
Very poisonous (46, 84, 148), can be fatal (82, 129).
In South Africa it grows singly or in groups under trees, especially oaks and *Eucalyptus* species after autumn rains. Common in the Transvaal (84, 158). Not as poisonous as *Amanita phalloides*, but may also be deadly. Nausea and vomiting may begin 1-3 hours after eating (158). Several cases of poisoning are known (33). A fatal case was reported from the Cape province in 1927 where a family mistook "*A. pantherina*" for edible mushrooms. Seven persons died (143). The symptoms were giddiness and weakness of the legs, with twitching, convulsive movements and signs of excitement[1] in some cases. All the patients became comatose 2-3 hours after eating the fungus during which state their respiration became deep and quickened slightly. Recovery from coma took five to ten hours and was followed by persistent abdominal pains and tenderness, accompanied by vomiting and purging. The identification of *A. pantherina* was probably correct but some of the symptoms, together with degenerative changes observed in the patient's livers indicate that *A. phalloides* was also involved (43). A case of pure *A. pantherina* poisoning reported of South Africa involved a family of four German immigrants and is described in detail by Bosman & al. (13). Typical symptoms, gastrointestinal and mental disturbances, caused by the

[1] This species is used for hallucinogenic purposes in North America! (133).

two major toxins in the species (muscarine-choline and L-hyoscyamine respectively), were observed.
Material of both *A. muscaria* and *A. pantherina* was gathered in the pinewoods near Cape Town University for chemical studies (83). This investigation revealed the presence in both species of a substance with the properties of L-hyoscyamine that is responsible for specific symptoms of poisoning (delirium, neurological signs, dilation of the pupils, etc.) with these mushrooms. This should be born in mind when assessing cases for treatment, since administration of atropine would aggravate the degree of poisoning (e.g. 143).
Some *A. pantherina* poisoning cases were also described from Zimbabwe (39, 43) where the number of poisoning cases by this species seems to increase annually (Sharp, pers. comm.). Confusion with "*A. rubescens*" growing in miombo woodland is compounded by an apparent trend for *A. pantherina* to encroach into litter under indigenous vegetation bordering coniferous or *Eucalyptus* plantations (139). According to Harris (53), some of the described cases are mistaken as *phalloides* poisonings and he also suggested a distinct individual reaction to the toxins present in the fungus.

Amanita phalloides (Fr.) Link — South Africa (33, 46, 84, 86, 143, 148, 149, 158, 163), Zambia (45).
Poisonous (46, 163), deadly poisonous (33, 148, 158): violent abdominal pains, excessive vomiting, thirst and diarrhoea precede death. Symptoms start 8-30 hours after eating (158).
It appears that no definite records of this fungus have been made in Malawi, but its prevalence throughout East Africa makes it highly probable that someone may come across it one rainy season (27). Reported both from Tanzania and South Africa, probably as a species introduced into plantations (116). In South Africa it grows under oaks, pines and poplars in early spring or autumn after heavy rains; singly or grouped (158). *Amanita capensis* A. Pearson & Stephens very probably represents a white form of *A. phalloides* (129) (see there).

In South Africa numerous cases of poisoning have been caused by this mushroom, as it is mistaken, especially by strangers, for the ordinary edible mushroom (86): an Indian cook died after eating *A. phalloides* (86); in 1955 four children and a Bantu in Ermerlo, Transvaal succumbed (149); deadly cases of poisoning are also described from the Harrismith District (143) and Ciskei (130). Also a case is known of people who were used to eat the I'Kowe (*Termitomyces umkowaanii*) in Natal but who were poisoned by *Amanita phalloides* which they mistook for the edible species in other parts of the country (Van der Westhuizen, unpubl. in 159).

In a Zambian case two adults showed symptoms of the phalloidine type of poisoning after they had eaten uncooked mushrooms; one victim died from hepato-renal failure two days after admission to hospital (45). *A. phalloides* was thought to be the possible agent but no fungus material could be identified.

Amanita praeclara (A. Pearson) Bas — Malawi (94).
Edibility unknown. Not considered edible in Malawi, but said by people in Zomba to kill flies (94).

Amanita reidii Eicker & Van Greuning — South Africa (37).
Regarding the edibility of this recently described species, nothing is yet known but because of a suggested close relationship with *Amanita phalloides*, it should be treated with great caution and is best avoided (37).

"***Amanita robusta*** Bouriquet" — Madagascar (16).
Invalid homonym of the edible *Amanita robusta* Beeli. Resembling macroscopically *A. strobiliformis* (16).
Toxic, at least to dogs (16). In an experiment with four dogs, both raw and cooked portions of 250 and 600 g caused serious symptoms and one dog succumbed. The symptoms were vomiting and, as showed by autopsy, congestion of liver and kidneys, copious production of gastric mucus, haemorrhages, etc.

"***Amanita robusta*** var. ***spinosa*** Bouriquet" — Madagascar (16).
A distinct species according to Bas [*Persoonia* **5**: 565 (1969)].
As in the case of *A. robusta*, proven to be poisonous to dogs (16).

Amanita rubescens (Pers.: Fr.) Gray — Malawi (94), South Africa (82, 129).
Poisonous if eaten raw, edible when cooked (82, 94, 129). An introduced species in South Africa where it is found chiefly in pine plantations and in association with other exotic trees such as *Quercus*.

Amanita tainaomby R. Heim — Madagascar (17, 19, 55, 59, 69).
First supposed by Heim (59) to be dangerous. Considered as being very poisonous by the local people of Madagascar (55). Later, Heim (69) reported of at least one poisoning incident which rapidly (after 1 hour) caused violent vomiting accompanied by tetanic contractions, dilatation of the pupils and Babinski's reflex.

Amanita vaginata (Bull.: Fr.) Lam. — Zambia (120).
Poisonous when eaten raw.

Amanita verna (Bull.: Fr.) Roques — Madagascar (164).
Deadly poisonous (164). It is not clear if this statement is based on African experiences.

Boletus

Boletus affinis Peck — Madagascar (127, 128).
Has a very bad reputation by the indigenous populations since it appears to be fatal to zebu cattle which have grazed on fruitbodies in the *Eucalyptus* forests (127, 128). No instances of human poisonings are yet recorded. The toxic compound, named bolaffinine, has been purified and was found to be a thermolabile protein with a high molecular weight (128). When injected into mice it proved fatal within 16-24 hours (LD_{50} = 61 mg/kg). After six hours the mice developed diarrhoea, loss of reflexes, dyspnoea and pulmonary oedema. Postmortem examination revealed liver damage (128). This bolete is therefore regarded as poisonous, at least when eaten raw, and prolonged cooking at high temperatures is recommended. In North America it is classified among edible mushrooms by some authors.

Boletus colossus = ***Phlebopus colossus***

Calvatia

Calvatia spec. – Central African Republic (62, 63).
A *Calvatia* species with a firm consistence is considered poisonous by the Lissongos.

Chlorophyllum

Chlorophyllum molybdites (G. Mey.: Fr.) Massee – Ghana (77), Kenya (22), Malawi (27, 93), Mauritius (112), Nigeria (1, 166, 167), South Africa (46, 148, 158, 163), Tanzania (99), Zaire (71, 156), Zambia (45, 116), Zimbabwe (88).
Reported regularly under the synonyms *Lepiota molybdites* (84); *Lepiota morgani(i)* (22, 112, 148, 163); *Leucocoprinus molybdites* (55).
Widespread in tropical and southern Africa, tropical regions and North America. In South Africa it grows in open grassy places after heavy late summer to autumn rains (158). One of the commonest fungi in Malawi where it is found in a variety of habitats [e.g. in grassy areas (27), with a tendency to grow near shrub vegetation and rubbish heaps] and at all altitudes from the lower River to the Montane forest of Tuchila Plateau (93).
Several *Chlorophyllum* species haven been distinguished in the literature (71) but it is clear that many more taxonomic and biochemical investigations are needed in order to clarify the confusion that exists relating to the toxicity and edibility of the genus.

Heim states (55) that this species replaces *Macrolepiota procera* in warmer regions and is an excellent edible mushroom used by the Arabs, Africans, Madagascans and the Amazonian Indians. However, his description of the spores does not agree at all with *C. molybdites* in its strict sense (71). In Nigeria the species is known as "Ojutun" (the king of the mushrooms) and is considered as poisonous (166) but Zoberi once bought a basketful from a woman who claimed that they were edible (167). A determination was impossible because he threw the mushrooms away since they were heavily infected with larvae. According to Zoberi, two types of fruitbodies are to be found in Nigeria, which probably also belong to two different species, and explaining why the species is sometimes considered as being edible. The fruitbodies of the "edible type" are found in large colonies, sometimes forming fairy rings in open woods and their flesh does not turn reddish when bruised, all other respects fitted *Chlorophyllum molybdites*.
In recent experiments in Nigeria, rats fed on a diet where "*C. molybdites*" supplied 10% of their protein intake showed rapid growth and a better protein efficiency ratio a control group. Furthermore, the aggressive behaviour and the extremely wild movements of the rats could be explained by the presence of hallucinogenic substances; in fact the Yoruba name of this mushrooms is "A jegba'ariwo-orun" which means "eat and hear voices from heaven" (1).

In most African countries it is considered as poisonous and dangerous by the local people (Ghana: 75; Zaire: 69, 154). In Malawi all woman knowledgeable about edible mushrooms and who were shown specimens of *C. molybdites* declare it to be without hesitation "Chikoko" (inedible) (93). Similarly, North American collections are regarded as poisonous. Gatherings from French Guyana were shown to contain a toxic substance, possibly an alkaloid, which was water soluble, and extremely labile with regard to time and place (40). Therefore, is has been suggested that the toxicity of the

fungus may depend upon climate and habitat factors (115, 166). Peerally & Sutra think that the oxidation (*read* detoxification) of poisonous aromatic amines in a later stages of development of the carpophores could explain the variation in toxicity observed for the species (112).

The continual risk of confusing between edible *Macrolepiota* species[2] and the toxic, green-lined parasol, *Chlorophyllum molybdites*, is the reported cause of several cases of mushroom poisoning in Africa, provoking 1-6 hours after ingestion gastrointestinal irritations: general inconvenience ("malaise"), nausea, heavy vomiting, curt cold sweating, headache, intestinal smarting (diarrhoea) and prolonged general physical tiredness. Treatment of symptoms were applied, after the gastrointestinal tract had been emptied by stomach lavage and purging.

In one Tanzanian incident (99), four people were submitted to hospital after eating this mushroom: three were suffering from poisoning and the fourth, who had picked this fungus, suffered from the beating-up by his angry relatives. In two case histories from Zambia (116) involving expatriate families, "*Lepiota morganii*" was identified (45) and this species was supposed also to be responsible for some other poisoning cases in which one with the death of a one-year old child. A patient in Kenya (22) became violently ill one hour after consuming the mushrooms, with vomiting, diarrhoea, severe abdominal pains, high pulse-rate and blood-stained mucus in the stools. Furthermore, the patient showed an unusual electrocardiogram with an "inversion of T wave in all precordial leads." Following medical treatment he recovered completely after two days. A case of gastrointestinal poisoning caused by "typical specimens of the green-lined parasol" is also described in detail from Zimbabwe (88).

Chlorophyllum molybdites var. ***congolensis*** (Beeli) Heinem. – Zaire (70, 71).

Claviceps

Claviceps fusiformis Loveless – Zimbabwe (85, 141).
In Zimbabwe, ergot of bullrush millet (munga, *Pennisetum typhoides*) was responsible for the death of thousands of piglets because sows farrowed without any milk (141). This phenomenon was first observed in former Rhodesia in 1953. Mammary glands of mother sows failed to develop normally when sows where feed with grain of *P. typhoides* infested by an *Claviceps* species, later described as *C. fusiformis* (85). Apparently a widespread African species containing alkaloids distinct from those that cause classical ergotism, a statement supported by the independent isolation of three new water-soluble alkaloids (agroclavine, elymoclavine, penniclavine) from pure cultures of a *Claviceps* species collected on *P. typhoides* in Chad (152) and almost certainly represented *C. fusiformis* (85).

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[2] A table with distinctive characters between *Macrolepiota* species and *Chlorophyllum molybdites* is given by Pegler & Rayner (117).

Claviceps paspali F. Stevens & J.G. Hall — South Africa (90, 163), Zaire (124, 156).
Cause ergotism in cattle but apparently not in horses, donkeys, sheep and goats. Effects on humans are unknown.

Claviceps purpurea (Fr.) Tul. — Zambia (154).
Apparently does not thrive to the extent of producing field poisoning in stock in South Africa (163) neither in Zaire where at least in the Shaba region no case of human poisoning has been reported (156). However, a case of poisoning causing ergotism is described from Mount Makulu (Zambia) where "*Claviceps purpurea*" occurs on bull rush millet (*Pennisetum typhoides*) and several other grasses (154). *Claviceps* poisoning could also explain 12 cases of peripheral gangrene from a village in the Concession area of Zambia (154).
It is important to be aware that, in spite of the relatively wide host range of *C. purpurea*, many determinations of *C. purpurea* should be treated with suspicion since many other *Claviceps* species are known to occur in the region[3]. The toxic properties of these species are unknown to us.

Clitocybe

Clitocybe spec. — South Africa (82).
Poisonous (82).

Clitocybe olearia = ***Omphalotus olearius***

Clitocybe toxica Stephens — South Africa (135, 146).
Invalidly published. Shown to be highly toxic for various laboratory animals (135) but effect on men unknown. The toxic effects do not appear to be due to muscarinic or cyanide action but to a potentially lethal factor that is destroyed by heat and among other actions, inhibits cytochrome oxidase (135). It is suggested to be avoided for human consumption.

Clitocybe venenata R. Heim — Central African Republic (64).
Considered by the Lissongos as being poisonous and fatal (64). The vernacular name is "Mosso kodo" (see also *Clitopilus octaristus* and *Lepiota cylindrospora*).

Clitopilus

Clitopilus octaristus R. Heim — Central African Republic (64).
Considered by the Lissongos as being poisonous and fatal (64). It is suggested by Heim that this is not necessarily true, as the species strongly resembles the poisonous species *Clitocybe venenata* (64) which shares the same vernacular name "Mosso kodo". The differences are primarily microscopic and *C. octaristus* differs also in having a strong odour and a different habitat. Nevertheless, it is also possible that "Mosso kodo" refers to a series of poisonous mushrooms of the muscarine-type (64).

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[3] See e.g. *Kirkia* **4**: 35-44 (1964); **5**: 21-28 (1965); **10**: 589-600 (1977); *Bot. J. Linn. Soc.* **91**: 489-491 (1985); *Trans. Brit. Mycol. Soc.* **50**: 19-22 (1967).

Collybia

Collybia spec. — Central African Republic (62).
Judging from its vernacular name "Bouangati," a *Collybia* species that provokes itchiness ("ngati" = scabies, itch).

Collybia dryophila (Bull.: Fr.) P. Kumm. — South Africa (46).
Poisonous (46). In Malawi considered as edible (93, 94) as in many northern temperate regions. However, a case of intoxication has been noted in North America and it was suggested that some races may be poisonous, at least to some individuals (7).

Coprinus

Coprinus africanus Pegler — Malawi (27), Nigeria (103).
A coprophilous fungus, in Malawi normally found growing on dung and other decaying organic matter (27). According to Singer (112) it obviously belongs to the subsection of the *Atramentarii*.
Containing a poison called coprine whose toxicity increases when taken with alcohol (27). Nigerian populations have also learned that it is safe to eat provided it is not immediately followed by drinking alcohol which makes it poisonous (103).

Coprinus atramentarius (Bull.: Fr.) Fr. — South Africa (82).
Edible, but not to be eaten before or after alcohol is consumed (82).

Coprinus ephemerus (Bull.: Fr.) Fr. — Nigeria (103).
Appears at night or early in the morning and within a very short time the pileus is fully expanded. As soon as the sun's rays touch it, however, it deliquesces, and it is due to this characteristic that the Yoruba people consider it poisonous. Yoruba native doctors use it in the preparation of some charms (103).

Coprinus erethistes R. Heim nomen nudum — Central African Republic (62, 63), Ivory Coast (63).
Invalidly published; systematic position unknown but most possibly related to *C. africanus*.
Toxicity effects similar to that of *C. atramentarius* and known by the Lissongo people who call it "Tongomokolo": "the mushroom that is turning head and heart when palm wine is drunk". Toxic properties are also known in the Ivory Coast where local people who have consumed this mushroom with alcohol say "your heart is attached to the air" (63).

Coprinus molestus Bouriquet — Madagascar (164).
Suspect.

Dictyophora = ***Phallus***

Dictyophora phalloidea = ***Phallus indusiatus***

Entoloma

Entoloma spec. — Madagascar (131).
Romagnesi (131) reports a case of poisoning in Marovoay region of Madagascar. The mushroom who caused the intoxication of a forester and some native people, according to its verbal description, could be an *Entoloma* species belonging to the group of *E. rhodopolium*.

Entoloma eulividum Noordel. — South Africa (163).

Entoloma lividum = ***Entoloma eulividum***

Gyromitra

Gyromitra esculenta (Pers.) Fr. — Zimbabwe (153).
Seven deaths out of nine natives affected in the Zaka region and five deaths of seven affected near Fort Victoria were reported after the victims had eaten wild mushrooms. The fungi had been eaten practically raw. According to Strover (153), these cases could have resulted from poisoning by fungi belonging to the group of "*Helvella esculenta*," which contain helvellic acid, a substance with powerful haemolytic properties and associated with the marked jaundice and haemorrhages observed (in fact caused by gyromitrin or a homologue). McCarter (88) however, feels that the description of the symptoms observed at the Fort Victoria poisoning case accords more closely to *A. phalloides*.

Hebeloma

Hebeloma spec. — South Africa (33).
An unnamed species of *Hebeloma*, common in the neighbourhood of Pretoria, is considered by some to be a good edible mushroom whereas others after eating a small portion of this mushroom are soon afflicted by headache, dizziness and cramp.

Hebeloma crustuliniforme (Bull.: Fr.) Quél. — South Africa (46, 82, 163).

Hebeloma sinapizans (Paulet: Fr.) Gillet — South Africa (82).

Helvella

Helvella esculenta = ***Gyromitra esculenta***

Helvella lacunosa Afzel.: Fr. — South Africa (46).
Edible when young (82) but carpophores should only be eaten if well cooked (46).

"***Helvella mitra*** L." — South Africa (163).
Said to be edible but Talbot thinks it is toxic (163). It is not clear in this case if "*Helvella mitra*" refers to *H. lacunosa*, *H. crispa* or *Gyromitra esculenta*.

Hericium

Hericium coralloides (Scop.: Fr.) Gray — South Africa (46).
Edible with caution.

Hiatula

Hiatula badhami = ***Leucocoagaricus badhamii***
Hiatula cepaestipes = ***Leucocoprinus cepaestipes***

Hypholoma

Hypholoma fasciculare (Huds.: Fr.) P. Kumm. — South Africa (163).

Inocybe

Inocybe asterospora Quél. — Madagascar (164).
Poisonous.
It is not clear if this was based on European literature data or African experiences.

Inocybe cincinnata var. ***major*** (S. Petersen) Kuyper - South Africa (148, 163).
Not very poisonous and considered dangerous only to children (148; based on European experience).

Inocybe eutheles = ***Inocybe sindonia***

Inocybe hirtella Bres. — South Africa (148, 163).
Poisonous (163), causing a slight intoxication of the muscarine type (148; based on European experience).

Inocybe lanuginella (Schröt.) Konrad & Maubl. — Zambia (120).
Definitively very toxic (120).

Inocybe obscura = ***Inocybe cincinnata*** var. ***major***

Inocybe sindonia (Fr.) P. Karst. — South Africa (46, 148, 163).
Poisonous (46, 163), causing a slight intoxication of the muscarine type (148; based on European experience).

Inocybe tulearensis Dufour & Poisson — Madagascar (164).
Suspect.

Lachnocladium

Lachnocladium schweinfurthianum Henn. — Zambia (120).
"Shows the general form of several harmful species."

Lachnocladium strictum = ***Ramaria moelleriana***

Lentinus

Lentinus squarrulosus Mont. — Malawi (93).
Interestingly, in Malawi the term "Kamsempha," used for the edible *Lentinus squarrulosus* and *L. cladopus* is clearly related to the complaint "Tsempho," a sickness associated with adultery and transmitted through "Ndiwo," the traditional mushroom stew (93). It most probably refers to occasional digestive disorders associated with this though mushrooms.

Lenzites

Lenzites elegans (Fr.) Pilát — Zaire, Shaba region (12).
Cited as poisonous by Beeli (12). This could not be confirmed by Thoen (156) who found it to be used in traditional medicine.

Lenzites palisotii = ***Lenzites elegans***
Lenzites repanda = ***Lenzites elegans***

Lepiota

Lepiota s.l. spec. — Madagascar (55), Zambia (120).
An unidentified *Lepiota* species from Madagascar is reported as suspect (55).
Pearce advises not to eat small *Lepiota* species in Zambia (120).

Lepiota badhami = ***Leucoagaricus badhamii***

Lepiota cylindrospora R. Heim — Central African Republic (67).
Considered as poisonous by the Lissongos who call it "Mosso kodo" (67; see also for *Clitocybe venenata, Clitopilus octaristus*).

Lepiota henningsiana Sacc. & Dom. — Cameroon (76).
Considered poisonous by the indigenous populations (76).

Lepiota morgani = ***Chlorophyllum molybdites***
Lepiota pulveracea Henn. = ***Lepiota henningsiana***

Lepiota rabarijanonae Bouriquet — Madagascar (164).
Suspect.

Lepiota roseoalba Pat. [non *L. roseoalba* Henn. = *Leucoagaricus roseoalbus* (Henn.) Heinem.] — Madagascar (164).
Suspect.

Lepiota subincarnata J.E. Lange — Kenya (117).
"Regarded as poisonous" (117). Not clear if there has been any case of poisoning in Africa or if the species is regarded as toxic by the local population.

Lepista

Lepista caffrorum (Kalchbr. & MacOwan) Singer — South Africa (150, 163).
Steyn & Talbot (150) investigated the toxicity of this mushroom because the tasting of small portions of it induced symptoms of poisoning such as headache, giddiness and colic after a long latent period of 24 hours (150), although other persons had eaten the same species of mushroom without impunity. Fresh material administered to rabbits caused symptoms of intoxication and post-mortem findings resembling those known of *Amanita phalloides* and *A. muscaria* (150). As *Lepista caffrorum* is generally considered to be an important edible mushroom (126), it is not clear if this toxicity is due to individual sensitivity, or is based on incorrect determinations.

Leucoagaricus

Leucoagaricus badhamii (Berk. & Br.) Singer — Madagascar (17, 19, 55), Zaire (156).
Known in Zaire to cause more or less serious illness (156). In Madagascar, this reddening *Lepiota* species has probably been confused with the "Ola bala" (*Leucocoprinus cepaestipes)* of the peoples in the South or with the "Akohody" (*Chlorophyllum molybdites*; considered edible by Heim), and has been responsible for serious illness in Sainte-Marie (comm. of Genet to Heim) where indigenous prisoners have confused it with a whitish "*Lepiota*" species [in fact *Volvariella volvacea* as indicated later (57)]. The symptoms were characterised by diarrhoea and vomiting followed by a long-lasting weakness (55).
It is not impossible that it also refers to the "Nâm-ngua" of the Annamites, a poisonous *Lepiota*-like species (55).

Leucocoprinus

Leucocoprinus spec. — Tropics (165).
According to Zoberi (165), a single yellow species has been reported to be very poisonous.

Leucocoprinus birnbaumii (Corda) Singer — Zaire (72).
Not consumed by the indigenous people, could be poisonous.

Macrolepiota

Macrolepiota species are generally regarded as good edible species but due to confusion with the poisonous green-lined parasol, *Chlorophyllum molybdites*, they are sometimes considered as poisonous. A useful table

contrasting the characters of both *Chlorophyllum molybdites* and *Macrolepiota* is given by Stephens & Kidd (147).

Macrolepiota rhacodes (Vittad.) Singer – South Africa (82).
Edible and pleasant-tasting but may cause stomach upsets in some people (82).

Morchella

Morchella conica Pers. – South Africa (82, 163).
"Poisonous" (163). Marloth (86) regard it as edible and as one of the most estimated edible mushrooms of central Europe (163). Poisonous when raw, edible when cooked, but produces a toxic liquid which must be discarded. Best avoided (82).

Morchella esculenta (L.) Pers. – South Africa (163).
Edible under certain conditions (163). Reported on two occasions from near Cape Town but it is probable that the fungus was mistaken for *M. conica* (163).

Omphalotus

Omphalotus olearius (DC.: Fr.) Singer – Tropics (165), Malawi (27), South Africa (46, 82, 148, 163).
Poisonous (27, 46, 82); causing gastrointestinal problems (148). Severe cases of gastrointestinal poisoning have frequently been reported from the tropics (165).
The description given in Chipompha (27) has been based solely on specimens described in the literature as the collections from Malawi were not very satisfactory; it would seem that the species is abundant on decaying stumps and rotten roots in the country.

Omphalotus cfr. ***olearius*** (DC.: Fr.) Singer – Kenya (117).
The fungus is toxic and serious cases of gastrointestinal poisoning have frequently been reported [a general remark not based on African experiences].

Panaeolina

Panaeolina foenisecii (Pers.: Fr.) Maire – South Africa (46).
Poisonous (46). Regarded by several authors to contain hallucinogenic substances but this is repudiated by the investigations of Stijve et al. (151).

Panaeolus

Panaeolus species – South Africa (163).
Poisonous (163). In Australia (and East Africa?) the eating of *Panaeolus* species is reported to be followed by unpleasant symptoms in 20 minutes, namely, numbness in the arms and legs, coloured lights in the field of vision and a "hysterical" state (Trotter, cited in 22). Nothing seems to be known about the composition of *Panaeolus* species of Southern and Eastern Africa but it should be noted that several *Panaeolus*-like species are known to contain hallucinogenic substances (e.g. 133).

Panaeolus campanulatus = ***Panaeolus papilionaceus***

Panaeolus papilionaceus (Bull.: Fr.) Quél. — South Africa (46).
Poisonous (46).

Paxillus

Paxillus involutus (Batsch: Fr.) Fr. — South Africa (46, 82).
Poisonous (46), possibly deadly (82) [not clear if based on African experiences].

Phaeogyroporus = *Phlebopus*

Phallus

As stated in the introduction, phalloid fungi receive a bad reputation as poisonous mushrooms by several African populations, mostly due to mythical beliefs.

Phallus aurantiacus Mont. — Nigeria (104).
Generally recognised by Nigerian people to be poisonous, most probably due to its odour and mythological beliefs.

Phallus indusiatus (Vent.) Pers. — Madagascar (17, 19, 55).
In Madagascar, stinkhorns such as *P. indusiatus* have a bad reputation and are considered poisonous by local peoples (17, 19, 55, 164). This may be well be due to the disagreeable and penetrating foetid odour that several stinkhorns possess (55).

Phlebopus

Phlebopus colossus (R. Heim) Singer — Burundi (73), Ghana (56), Madagascar (17, 19, 55, 65, 164), Zaire (73).
Suspect, but not confirmed (65). Erroneously considered as (very) poisonous by some indigenous populations (17, 19, 55, 56). In reality, difficult to digest (17, 19, 55, 164), and causing indigestion according to local populations in tropical Africa (55, 56, 73). Edible when cooked (56).

Phlebopus portentosus (Berk. & Br.) Boedijn: see ***Phlebopus sudanicus***

Phlebopus sudanicus (Har. & Pat.) Heinem. — Kenya (117), West Africa (93, 94).
Synonymized by Pegler (115) with *Phlebopus portentosus* but Heinemann & Rammeloo [*Mycotaxon* **15**: 395 (1982)] consider the latter as a closely related species only recorded from Asia and Australia.
In West Africa and Kenya it has been reported by local tribes to cause intoxication when eaten (93, 94, 117). Williamson writes that in Malawi it is dried before cooking and eaten as "Ndiwo" (93).

Pleurotus

Pleurotus olearius = ***Omphalotus olearius***

Podaxis

Podaxis pistillaris (L.: Pers.) Fr. — Nigeria (4), South Africa (158).
Regarded as inedible in South Africa (158) and the Nupes in Nigeria regard the fungus as poisonous (4). It is, however, an important edible species in Asia (10).

Psalliota = *Agaricus*

Psathyrella

Psathyrella atroumbonata Pegler — Nigeria (1).
Eaten in Nigeria and Malawi. However, in an experiment where rats were fed on a diet where *P. atroumbonata* supplied 10% of the protein intake, the animals lost considerable weight after ten days or had died, indicating the possible presence of toxic factors in the raw mushroom (1). The diet was not well accepted which might also indicate lack of palatability.

Psilocybe

Psilocybe merdaria (Fr.) Ricken — Kenya (28, 117).
Cullinan et al. (28) reported the occurrence of instances of mushroom poisoning from Kenya in 22 out of 23 persons in four episodes over three days, as well as in three other persons a week before. The toxin was stated to affect the central nervous system. The symptoms are described in detail and are typical for hallucinogenic poisoning.
The dark lamellae and the presence of an annulus have caused the fungus to be mistaken for another species of edible mushroom (117). The mushroom was first identified by Rayner as a *Stropharia* species (28) and later regarded as an African form of *Stropharia cubensis* (Earle) Singer by Heim & Wasson [*Arch. Mus. Natl. Hist. Nat. Paris, sér.* 7(6): 190-191 (1958)]. Finally, Pegler examined the original description and spore print and identified it as *Psilocybe merdaria*. Some other hallucinogenic poisoning cases reported from Kenya (22, 23) were possibly also caused by *Psilocybe* species (presumed as *Stropharia* species).

Psilocybe semilanceata (Fr.) P. Kumm. — South Africa (46).
Poisonous (46). Hallucinogenic characteristics well known in North America and Europe (133).

Pulveroboletus

Pulveroboletus aberrans Heinem. & Gooss.-Font. — Malawi (93).
Williamson (cited in 91) suggested it may be edible, and her notes have the comment "boil, throw away water and dry; verify." As with several other boletes (e.g. *Suillus granulatus*, *Phlebopus* spp.) it may be slightly poisonous when eaten raw and edible after boiling and drying, washing out any toxic substances in the process (93).

Pycnoporus

Pycnoporus sanguineus (L.: Fr.) Murrill – South Africa (46).
Poisonous. A doubtful statement because it has also been cited as to be edible when fleshy (93). Furthermore it is used in traditional medicine and occasionally as a dye.

Ramaria

According to Zoberi (165), most tropical *Ramaria* species are edible but some are poisonous. This statement, however, gives no details on the situation for Africa.

Ramaria formosa (Pers.: Fr.) Quél. – South Africa (82).
Poisonous. Bitter tasting and causing diarrhoea.

Ramaria moelleriana (Bres. & Roum.) Corner – Cameroon (75).
Poisonous according to the collector (Zenker).

Rhodophyllus = ***Entoloma***

Russula

Russulaceae – Gabon (162), Madagascar (58), Tanzania (50), Zambia (119).
According to Heim (58) it is doubtful wether any single *Lactarius* or *Russula* species of Madagascar is poisonous. However some species should be avoided on account of their taste. In Zambia, some Russulaceae are regarded as poisonous by the local populations unless cooked in an alkaline solution of plant ash (119). In Tanzania (50), several *Russula* species are considered inedible; e.g. some brownish species are called "Kansalaghe" by the Sukuma tribe, a general name for inedible or poisonous mushrooms. Finally, in Gabon, a *Lactarius*-like mushroom is also regarded as poisonous (162).

"***Russula emetica*** (Schaeff.) Pers.: Fr." – Malawi (27).
Poisonous (27). However, the species is depicted with strongly decurring lamellae and is therefore obviously not *R. emetica*.

Scleroderma

Scleroderma citrinum Pers. – South Africa (46).

Stropharia

Stropharia div. spec. – Kenya (22, 23), South Africa (163).
Stropharia coronilla, *S. melanosperma*, *S. semiglobata*, *S. squamosa* var. *thrausta* are all non-poisonous and, according to Stephens, there are no records from South Africa relating to poisonous effects from the eating of *Stropharia* species (163).
The "*Stropharia* species" which caused severe cases of hallucinogenic poisoning in Kenya (28) was later found to be *Psilocybe merdaria* (117). Furthermore, Charters (22, 23) also reported a case of "*Stropharia*" poisoning in Kenya with similar mental symptoms (visions, euphoria, delusions, happiness, etc.) and recovery completed

within six hours, following gastric lavage: again this determination is not quite certain and this psychotropic poisoning could also be attributed to a *Psilocybe* species.

Suillus

Suillus granulatus (L.: Fr.) Kuntze — Madagascar (128), South Africa (82), Zambia (122).

In general considered as edible (126) but may, with sensible persons, cause severe enterocolitis, sometimes accompanied with cardiovascular troubles (128). In South Africa, it is recommended to remove the slimy cuticle of the cap of *Suillus* species before cooking (82). The commonsense precaution of avoiding over-mature specimens is also recommended as they may be toxic (122).

Termitomyces

Termitomyces robustus (Beeli) R. Heim — Nigeria (1).

Regarded as a good edible species in several African countries. However, in an experiment where rats were fed on a diet with *T. robustus* dried at 60 °C for 48 hours supplying 10% of their total protein, a negative net protein retention value was recorded, despite the high digestibility and high intake by the animals (even so, one rat died). As was the case with *Volvariella esculenta*, this failure to support growth was probably due to unknown toxic, thermolabile factors (1).

Termitomyces striatus (Beeli) R. Heim — Nigeria (1).

A well-liked species in several African countries. However, rats that were fed on a diet where *T. striatus*, previously dried at 60 °C, supplied 10% of their total protein intake, lost weight rapidly, fell ill and died within four days (1). On the other hand, the same fungus fed to rats after drying at 90 °C for 8 hours, produced a marginal gain in weight and the animals did survive the experiments. Prolonged storage at 60 °C for 5-8 weeks also seemed to detoxify the poisonous component. Probably this *Termitomyces* species contains a heat-labile toxic factor and so should be considered as poisonous in the raw state.

Tricholoma

Tricholoma lobayense R. Heim — Nigeria (1).

Regarded as a good edible species in several African countries. However, in recent experiments where rats were fed on a diet with *T. lobayense* dried at 60 °C for 48 hours, supplying 10% of their total protein intake, male sterility was observed whereby they were unable to produce litters for 14 weeks even after mating with control females (1). Because this fungal species contains appreciable amounts of alkaloids and tannins, Adewusi et al. (1) recommend that it should be consumed sparingly until further research into detoxification processes are completed.

Tricholoma mauritianum Peerally & Sutra — Mauritius (111, 113).

Contains cyanide (111), just as is the case with *T. spectabilis*. Toxic when eaten raw, but excellent when cooked (113).

Tricholoma spectabilis Peerally & Sutra — Mauritius (111).
Toxic when raw causing both gastrointestinal and nervous troubles. Excellent when cooked (113). Having a hydrocyanic odour, it contains (just as *T. mauritianum*) cyanide (113).

Tricholoma ustale (Fr.: Fr.) P. Kumm. — South Africa (82).
Slightly toxic, with a very bitter taste (82).

Trogia

Trogia infundubiliformis (Berk. & Br.) Corner — Malawi (27).
Not edible, an illustration in the publication is even labelled "poisonous." The determination seems to be doubtful. The statement that "similar pink, yellow and orange mushrooms are known to be edible" almost certainly refers to the true *Cantharellus* species (27). Furthermore, *T. infundibuliformis* has been reported as edible in Zaire by Pegler (126).

Volvariella

Volvariella esculenta = ***Volvariella volvacea***

Volvariella volvacea (Bull.: Fr.) Singer — Nigeria (1).
Widely known in the tropics as a good edible species and regularly cultivated. However, in an experiment, rats fed on a diet where *V. volvacea*, dried at 60 °C for 48 hours, supplied 10% of their total protein intake recorded a more negative "net protein retention value" despite the high digestibility and the high intake by the animals (even so, one rat died). As it was the case for *Termitomyces robustus*, this failure to support growth was probably due to unknown (heat-labile ?) toxic factors (1).

2 USEFUL FUNGI

2.1 Fungi used as food

In an earlier paper (126), we discussed already the use of fungi as a food source in Africa south of the Sahara and listed about 300 species whose edibility has been discussed in the literature. We therefore limit the present chapter to some addenda and corrigenda[4] to the list of species reported to be edible in Rammeloo & Walleyn (126). Presentation of the data is similar to 1.5. Nomenclatural corrections are marked with *.

Further most interesting data will be found in books on the edible fungi of western Burundi (21) and Tanzania (in preparation by M. Härkönen & coll.).

Agaricus campestris var. ***praticola*** (Vittad.) Fr. — Madagascar (164).

**Amanita bingensis* (Beeli) J.-E. Gilbert = *Amanita bingensis* (Beeli) R. Heim

Amanita excelsa (Fr.) Bertol. — South Africa (129).
Edible when cooked but poisonous in the raw state; best avoided in view of the risk of confusion with *Amanita pantherina* (129).

Amanita foetidissima D.A. Reid & Eicker — South Africa (129).
Possibly edible but it would be unwise to experiment with this species (129).

Amanita strobiliformis (Paulet: Vittad.) Bertol. South Africa (129).
According to Reid & Eicker (129) it is very doubtful if this species really does occur in South Africa; most reports from South Africa of this species refer to gatherings of *Amanita roseolescens* and *Amanita foetidissima* (129).

**Amanita vaginata* (Bull.: Fr.) Vittad. = *Amanita vaginata* (Bull.: Fr.) Lam.

Amanitopsis pudica Beeli — Zaire (21).

Annelaria semiovata* f. *exannulata* = ***Panaeolus antillarum* (Fr.) Dennis

Cantharellus cyanescens Buyck — Burundi (21).

Cantharellus splendens Buyck — Burundi (21).

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[4] Minor corrections: *Scripta Bot. Belg.* **5**: 42 ["A" should be "Asia"]; ibid.: 51 [add scale "(x 2)"]; ibid.: 57 ["BOTTOMLY" should be "BOTTOMLEY"]; ibid.: 57-58 ["DE GREEF" should be "DEGREEF"].

Collybia attenuata R. Heim — Central African Republic (66).
Consumed by the Lissongos (66).

Collybia aurea (Beeli) Pegler — Burundi (21).

Coprinus castaneus Berk. & Br. — Mauritius (30, 31).
Regularly harvested from sugar-cane wastes by sugar estate workers in Mauritius (30, 31).

Coprinus cinereus (Schaeff.: Fr.) Gray s.l. — Tanzania (51).
This highly appreciated and rapidly perishable *Coprinus* species growing on sisal waste is adding appreciable amounts of protein to the diet of workers on sisal plantations in Tanzania (51).

Coprinus sterquilinus (Fr.) Fr. — Kenya (117).
Eaten by some indigenous tribes (117).

Corditubera bovonei (Mattir.) Demoulin & Dring — Zaire (8).
We presumed (126) that this species had not recorded since the time of its original gathering and description but it was reported later to be currently used as a truffle in Elisabethville (now Lubumbashi) (8; as *Scleroderma bovonei*).

Cortinarius largus Fr. — Madagascar (164).

Favolus alveolarius = ***Polyporus alveolaris***

Favolus brasiliensis* = ***Polyporus tenuiculus* (P. Beauv.) Fr.

Lachnocladium ochraceum = ***Ramaria ochracea***

Lactarius congolensis Beeli — Zaire (11).

Lactarius craterelloides R. Heim & Gooss.-Font. — Zaire.
The edibility of this species cited in our previous report is based on a misidentification of *Lactarius kabansus* (Verbeken, pers. comm.).

Lactarius edulis Verbeken & Buyck — Burundi (21).

**Lactarius gymnocarpus* R. Heim = *Lactarius gymnocarpus* R. Heim ex Singer

Lactarius hispidulus R. Heim — Zaire.
The edibility of this species cited in our previous report is based on a misidentification of *Lactarius kabansus* (Verbeken, pers. comm.).

Lactarius rubroviolascens R. Heim — Madagascar (164).
Probably edible (164).

Lentinus crinitus (L.: Fr.) Fr. — Zaire (Paulus & Musibono, pers. comm.; det. J. Rammeloo).

Lentinus tuberregium (Fr.: Fr.) Fr. — Nigeria (101, 102).
Nutritional data of this species have been published by Ogundana and Fagade (101, 102).

Lentinus velutinus Fr. — Zaire (Paulus & Musibono, pers. comm.; det. J. Rammeloo).

Lepiota acutesquamosa = ***Lepiota aspera***

Lepiota aspera (Pers. in Hoffm.: Fr.) Quél. — Madagascar (164).
Zeller (164) questions the edibility of this species in Madagascar considering that the "European variety" has no culinary value.

Lepiota canescens* = ***Leucocoprinus truncatus* (A. Pearson) D.A. Reid & Eicker

Leucocoprinus cretatus Locq. ex Lanzoni — Madagascar (55).
Referred to as *Hiatula cepaestipes* (Sowerby: Fr.) R. Heim & Romagn. var. *cretacea* (Bull.) R. Heim but highly possible representing *L. elaidis* (Beeli) Heinem.
In Madagascar, considered as suspect by the indigenous populations. This *Lepiota* species is very likely to be edible in spite of its affinities with *L. badhami* (55). It is almost certain that it is the consumed "Näm chac" consumed by the Annamites.

Lepiota grassei R. Heim ex R. Heim — Guinea (61, 68).
An termitophilous agaric well-liked by several indigenous populations of Guinea.

Lepiota nanisanae = ***Leucocoprinus nanianae***

Lepiota praeclara* = ***Amanita praeclara* (A. Pearson) Bas

Lepiota roseolescens* = ***Amanita roseolescens* (A. Pearson & Stephens) Bas

Leucoagaricus rhodocephalus (Berk.) Pegler — Zanzibar (114).

Leucocoprinus nanianae Bouriquet — Madagascar (18, 164).
Edible according to local populations (18, 164). A cooked portion fed to a dog provoked no ill effects (6).

Lycoperdon endotephrum Pat. — Madagascar (164).
Eaten at the eastern coast of Madagascar (164).

Macrolepiota procera var. ***vezo*** L.M. Dufour & H. Poiss. Madagascar (164).

Marasmius arborescens (Henn.) Beeli — Zaire (Paulus & Musibono, pers. comm.; det. J. Rammeloo).

Marasmius cfr. ***grandisetulosus*** Singer — Zaire (Paulus & Musibono, pers. comm.; det. J. Rammeloo).

Marasmius piperodorus Beeli — Congo (144).

**Morchella esculenta* Pers.: Fr. = *Morchella esculenta* (L.) Pers.

Oudemansiella canarii (Jungh.) Höhn. — Zaire (Paulus & Musibono, pers. comm.; det. J. Rammeloo).

Podaxis pistillaris (L.: Pers.) Fr.
The claim by Morse that African natives eat this species was regarded as suspect by some authors, but it remains highly possible that Morse's statement is based on truth since *Podaxis* species represent a food source of considerable economic importance in Afghanistan and Pakistan (10).

Polyporus alveolaris (DC.: Fr.) Bondartsev & Singer — Zaire (2, 26).

Polyporus moluccensis (Mont.) Ryvarden
According to Ryvarden (134) eaten in Zambia (118) and Malawi (93).

**Psalliota termitum* = *Agaricus* species, probably close to *A. campestris* (68)

Ramaria ochracea (Bres.) Corner — Zaire (32).

Russula ciliata Buyck — Tanzania (50).
Eaten by the Nyamwezi and Sumbwa peoples in Tanzania.

Russula compressa Buyck — Tanzania (50).
Eaten by the Nyamwezi, Safwa, Sukuma and Sumbwa peoples in Tanzania.

Russula congoana Pat. — Tanzania (50).
Eaten by the Nyamwezi and Sukuma peoples in Tanzania.

Russula heimii Singer — Tanzania (50).
Eaten by the Safwa and Bena peoples in Tanzania.

Russula hiemisilvae Buyck — Tanzania (50).
Eaten by the Simbwa people in Tanzania.

Russula liberiensis Singer — Tanzania (50).
Eaten by the Safwa and Bena peoples in Tanzania.

Russula madecassensis R. Heim — Madagascar (9, 164).

An excellent and easily recognisable species (164) formerly featuring in the list of edible species authorized to be sold at the town markets of Tananarive (now Antananarivo) (9).

Russula phaeocephala Buyck — Tanzania (50).
Some Nyamwezi people consider it edible.

Russula sublaevis (Buyck) Buyck — Tanzania (50).
Eaten by the Nyamwezi people in Tanzania.

Russula tanzaniae Buyck — Tanzania (50).
Eaten by the Nyika people in Tanzania.

Scleroderma bovonei* = ***Corditubera bovonei* (Mattir.) Demoulin & Dring

Strobilomyces costatispora* = ***Afroboletus costatisporus* (Beeli) Watling

Strobilomyces coturnix Bouriquet — Madagascar (164).
Edible according to Zeller, judging from its taste (164). An undetermined *Afroboletus* species, according to Heinemann & Rammeloo (in preparation).

Stropharia squamosa* var. *thrausta* = ***Psilocybe squamosa* var. ***thrausta*** (Schulzer ex Kalchbr.) Guzmán

**Suillus bovinus* var. *viridocaerulescens* A. Pearson = *Suillus bovinus* var. *viridocaerulescenes* (A. Pearson) Singer

Termitomyces clypeatus R. Heim — Nigeria (101, 102).
Nutritional data of this species have been published by Ogundana & Fagade (101, 102).

Termitomyces robustus (Beeli) R. Heim — Nigeria (101, 102).
Nutritional data of this species have been published by Ogundana & Fagade (101, 102).

2.2 Fungi used in traditional medicine and mythological practices

2.2.1 Introduction

As far as we know, the use of fungi in traditional medicine in Africa is not a widely spread phenomenon as it is, for example, in Asia. Morris found little evidence of macrofungi being used in traditional medicine in Malawi (91) neither did Piearce in Zambia (119) nor Thoen et al. in Shaba (Zaire) (156).

With the exception of well documented data on Yoruba land in Nigeria, literature data are very dispersed, scarce and rather old. References are known from:

Africa (general) (97, 155);
West Africa (78):
- Benin (6);
- Nigeria (100, 103, 104, 105, 106);
- Senegal (79, 137);

Central Africa:
- Central African Republic (62, 63),
- Gabon (162);
- Zaire (125, 156);

East Africa:
- Kenya (34, 80, 134),
- Malawi (91, 93);
- Tanzania (36, 48, 134); Zanzibar (74);
- Zambia (142, 162);

Madagascar (29, 54, 81);
Southern Africa:
- Namibia (35, 157);
- South Africa (14, 82, 163).

2.2.2 Medicine or mythology?

The literature data which refers to the use of mushrooms in traditional medicine is treated here, together with their use in mythological practice. Some mushrooms used as a medicine are also used in the preparation of charms. An especially close link between mythology and traditional medicine is known from the Yoruba people (Nigeria), where herbalists and diviners have long recognized the potency of fungal extracts: the ability to heel the sick, find lost objects, induce supernatural powers, including the ability to reach the realms of the gods or become invisible in the face of danger (3). Apparently, fungi sometimes play an important role in African mythology, judging from some mythological tales and beliefs known from Nigeria (100, 103, 104, 105, 106), Zambia (119), Gabon (162), Madagascar (54) and Zaire

(125). Furthermore, medicinal use of several mushrooms can be explained by the signature theory that relates the use of plants or animals to the shapes or colours of body parts: e.g. remark the link between the lashed eye-like *Galiella javanica* and its use in treatment of ophthalmia, the popular use of sclerotia, etc.

However, at least seventeen mushroom species of Europe and Asia have been proved to contain medicinally effective and health promoting compounds (38). *Claviceps purpurea*, formerly used in European traditional medicine, is considered suitable for the production of ergometrine in developing countries (145). A chytochalasan (anti-biotic mould product) has been isolated from *Engleromyces goetzei* (80, 110), used in traditional medicine in Kenya. Therefore, it would be unwise to consider all uses of African fungi in traditional medicine as inappropriate for applied sciences. More ethnomycological surveys and chemical investigations are needed to clarify the situation.

2.2.3 List of species reported to be used in traditional medicine and mythological practices

Amanita alliidora Pat. — Madagascar (44).
According to indigenous populations the strong garlic odour of this possibly poisonous species prevents headaches.

Battarrea guicciardiniana = ***Battarrea stevenii***

Battarrea stevenii (Libosch.) Fr. — Namibia (157).
Used by the Topnaar people of the Namib desert who rub the spores on burns to reduce the pain and hasten healing. Also rubbed on rough skin of the body. Spores mixed with fat or "!nara"-oil or with a ground red stone are used as cosmetic and to protect the skin from sunburn and drying out (157). Furthermore, Pisani (35) observed in this region, a mixture of *Battarrea* spores and fat to be rubbed on septic udders of cows and ewes.

Calvatia cyathiformis (Bosc) Morgan — Nigeria (100, 105), South Africa (14).
Said to be medicinal (14). Used by the Yoruba people of Nigeria ground with *Daldinia concentrica* and mixed with African black soap as a remedy for leucorrhea. The soap compound is used by the patient as a vaginal douche at prescribed intervals. By the same people it is used in another preparation (to be administrated orally) against "Maasomaaso," which is probably the disease known in the orthodox medicine as pneumaturia (105). In Nigeria also, a main ingredient of the native medicine for the treatment of food poisoning (100).

Coprinus ephemerus Fr. — Nigeria (103).
This mushroom appears at night or early in the morning and within a very short time the pileus is fully expanded. As soon as the sun's rays touch it, however, it deliquesces. Because of this characteristic the people consider it to be poisonous and the Yoruba native doctors use it in the preparation of some charms (103).

Daldinia spec. — Gabon (162), West Africa (78).
Walker's description of a mushroom forming a globulous mass with black and grey rings clearly refers to a *Daldinia* species (162). It is used by all the populations from the coast to the interior land in Gabon for its purgative properties, absorbed with a banana grilled on the ash, or cooked with sorrel or "Odika" (162).
According to Holland (78) used by natives of West Africa as purgative medicine, in the form of a ball about half an inch in diameter consisting of mashed fruitbody mixed with the juice of half a lime.

Daldinia concentrica (Bolton: Fr.) Ces. & De Not. South Africa (82).
Not edible. Its popular name "Cramp-ball" derives from a belief that carrying a couple of these balls in one's pocket would prevent cramp (82).

Engleromyces goetzei Henn. — Kenya (34, 80).
Duke (34) first reported in 1926 on the medicinal use of this parasite that grows on the upper parts of the stems of mountain bamboo (*Arundinaria alpina*) since it was "much sought after by natives as a stomach medicine." A comprehensive report on the use in traditional medicine of this fungus is given by Kokwaro (80): "all fevers (flu and colds, pneumonia, headaches, malaria, mental diseases, and thrush) are treated by burning the fungus and inhaling the smoke, boiling the fungus and inhaling the steam, by simply chewing the fresh material, or by licking up the ash of the burned fungus. A decoction or infusion is used as a purgative and the species is also employed for the relief of several systemic complaints, including liver disease and abdominal pain. Chemical analysis of the fruitbodies has resulted in the isolation of engleromycin, a new cytochalasan (110) which is an anti-biotic mould product.
Apparently *Engleromyces goetzei* is still highly esteemed by local populations in Kenya. The species also occurs in other afro-alpine zones in Tanzania, Uganda, Zaire but it's use in traditional medicine for these regions is unknown.

Fomes spec. — Tropics (165).
According to Zoberi some *Fomes* species are known to be of medicinal use in the tropics but it is not clear if African species are involved.

Fomes rimosus = ***Phellinus rimosus***

Galiella javanica (Rehm) Nannf. & Korf — Madagascar (81).
Used as a medicine against ophthalmia.

Ganoderma curtisii (Berk.) Murrill — Central African Republic (62, 63).
Used by the Lissongos against intestinal disturbances, especially from the spleen.

Lentinus tuberregium (Fr.: Fr.) Fr. — Madagascar (29, 54, 123), Nigeria (106, 167), Tanzania (36, 74).
The sclerotium of *L. tuberregium* serves the natives as food and is used also for medicinal purposes in the tropics, as e.g. observed in Zanzibar by Hennings (74). Both the sclerotium and the fruitbodies are edible and used as food.
In Nigeria, extensively used in traditional medicine for stomach pain, constipation, headache, fever, cold, chest pain, dropsy, smallpox, boils, asthma, control of high blood pressure, nervous disorders and for the development of the foetus during pregnancy (106, 167). These uses vary from state to state (106). Chromatographic

analysis of sclerotia of Nigeria (167) showed the presence of glucose, fructose, mannose, galactose, sucrose, inositol, maltose, cholesterol, palmitic acid, oleic acid and stearic acid (0.32% reducing sugars, 45.94% proteins). Analysis of ash revealed the presence of 0.271% potassium and 0.0039% sodium (167).
In Madagascar it is used for headache (123) and believed to counteract the absorption of the poison of the tree *Cerbera venenifera* (Apocynaceae) (54). This use of *Lentinus tuberregium* as an antidote was already noted down by the naturalist Chapelier in 1804 (i.e. against seeds of *Combretum coccineum*). Heim also observed an important use of the sclerotia in sorcery in Madagascar, where pregnant woman are permitted to enter the hut of a deceased man only after eating powdered *L. tuberregium*. The powder of the sclerotia is believed to protect against thunder and lightning and a person can rid himself of sin by rubbing grated sclerotium on the forehead and cheeks.
The carpophores, but not sclerotia, are used in Tanzania to treat intestinal catarrh (36). The mushrooms are boiled in water for half an hour and the cooled infusion is then drunk. When this results in subsequent diarrhoea, the person is considered healed. Similar uses in traditional medicine were not observed in Shaba, Zaire (156).

Lentinus velutinus Fr. — Nigeria (100).
Not edible but the myths attached to its discovery prompted the people to use it medicinally (100). Also used for the preparation of charms to ward off enemies.

Lenzites elegans (Fr.) Pilát — Zaire (156).
In Shaba (Zaire), the carpophores of this and other closely related white species are burnt and the ash is mixed with oil and smeared on mouth wounds.

Lenzites palisotii = ***Lenzites elegans***
Leucoporus sacer = ***Lignosus sacer***

Lignosus sacer (Afzel.: Fr.) Ryvarden — Central African Republic (62, 63), Kenya (134), Tanzania (134).
Widely used in traditional medicine in Asia (China, Malaysia). It was first described from Guinea by Afzelius as "*Boletus sacer*" (holy bolete) since it was considered as a divine object by West African indigenous populations (155).
Sclerotium, stipe and cap are used by the Lissongos in the Central African Republic against intestinal diseases (62, 63). Ryvarden was told that in Kenya and Tanzania it is used for the relief of stomach complaints (134). Not used in Shaba (Zaire) (156).

Lycoperdon spec. — Tropics (165).
The mass of spores and the capillitium were at one time used for staunching the bleeding of wounds in tropical regions but it is not clear if this use is also known from tropical Africa.

Panus fulvus[5] = ***Lentinus velutinus***
Penzigia papyrifera = ***Xylaria papyrifera***

Perenniporia mundula (Wakef.) Ryvarden — Malawi (91, 93).
These fungi are often to be seen on market stalls in Malawi, where they are sold as medicine. The fungus is used by men to "give strength," the ashes being rubbed into incisions made on the arms. The fungus may also be warmed over a fire and then placed near the kidneys or on the chest as a remedy for "Chisoma" or "Chibaya" (pleurisy) (93). Reported also in the treatment of impotency (91).

Phallus aurantiacus Mont. — Nigeria (104)
This species, as well as related stinkhorns, is used in the preparation of evil spells capable of causing insanity and charms to make one invisible in the face of danger. Also used as a cure for leprosy (104).

Phallus indusiatus (Vent.) Pers. — Zaire (125).
Being burned, the ashes are rubbed into superficial incisions in the skin for curing paralysed parts of the body.

Phellinus rimosus (Berk.) Pilát — Zambia (142, 163).
Found in southern Africa on a great variety of hosts. In Zambia the fungus is collected by the Lamba from *Burkea africana*, reduced to ash, mixed with salt and taken as a remedy for colds and coughs. The ash alone is often sprinkled on wounds to stimulate scab-formation (163). Sikombwa & Piearce (142) believe that this fungus was misidentified and in fact is really *Vanderbylia ungulata*.

Phellinus spec. — Tanzania (48).
Inhaling the smoke of burnt pieces of the woody growth of a *Phellinus* spec. growing on *Olea africana* is recommended by a herbalist to cure headache.

Pleurotus tuberregium = ***Lentinus tuberregium***

Podaxis pistillaris (L.: Pers.) Fr. — Africa (97), South Africa (163).
Has been used in the treatment of cancer especially as a local application to carcinomatous ulcers (163[6]). Used by natives in Africa to cure cancerous sores (97).

Polyporus spec. s.l. — Benin (6), Senegal (79, 137).
Two polyporous species are used in Senegal to produce "Amadou," a traditional medicine used for stopping light superficial haemorrhages and nose-bleed and to maintain the moisture of the skin (137). A more recent account on the use of an

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[5] We interpreted the "Panus falvus" and "Panus flavus" of the original article (100) as *Panus fulvus*, excluding the possibility that it refers to the Nigerian *Panus flavidus*, a synonym of *Lentinus tuberregium* which is also discussed in that paper (under the name of the edible *Pleurotus tuberregium*).

[6] Cited from Pappe L. (1857) — Flora Capensis Medicae Prodromus (2 ed.). Cape Town: Brittain; Thunberg C.P. (1790?) — Travels in Europe, Africa and Asia made between the years 1770-1779. London: W. Richardson.

unidentified polypore in that country is given by Kerharo & Adam (79: 559): Diola people treat certain mental diseases with baths and potions of root extracts of *Acacia albida* and bark of *Afzelia africana*. This treatment is completed by inhaling the smoke of slowly combusted "Karakat," a polypore collected from the base of *Parkia* or *Parinari* species. Apparently, similar uses exists among North American native populations. Polypores, called "wood tumours," were also used in traditional pharmacopoeia in Benin (6) to cure menstrual problems and various intestinal diseases. Dried or fumigated carpophores are reduced powder and mixed with pepper or onion diluted in corn milk or water.

Pycnoporus spec. — Gabon (162).
An extract of a blood-red polypore is used by the Akèlès against intestinal worms, and most probably refers to a *Pycnoporus* species (162).

Pycnoporus sanguineus (L.: Fr.) Murrill — Zaire (156).
Most commonly used in traditional medicine in Shaba, Zaire (156). First carbonized on a strongly heated sheet of iron, the ash is grounded and mixed with oil (usually palm-oil). This mixture is put on 2-3 weeks old babies' heads and is believed to accelerate the closure of the cranial sutures (fontanelle). In the same region, the species is also used to cure headache.

Sarcosoma javanicum = ***Galiella javanica***

Termitomyces globulus R. Heim & Gooss.-Font. — Nigeria (105).
Used by the Yoruba hunters to prepare a magical potion. The mushroom is chewed with seven seeds of *Afromomum melegueta* and the leaf of *Phyllanthus floribundus*. When this is spat on the palm and rubbed on the gun or the bow and arrow together with appropriate incantations, the hunted game becomes drowsy and easy to kill.

Termitomyces microcarpus (Berk. & Br.) R. Heim — Nigeria (105).
Used by the Yoruba native doctors for the treatment of gonorrhoea (105). The fruitbodies are prepared, together with the pulp of *Cucurbita pepo*, leaves of *Cassia alata* and various other ingredients and swallowed (105). Also used by Yoruba native doctors as an ingredient in the preparation of good luck charm, particularly for traders and, in combination with other ingredients, in a propitiation to the gods for increased population in towns and villages by reducing mortality rate.

Termitomyces robustus R. Heim & Gooss.-Font. — Nigeria (105)
Traditional doctors of the Yoruba (Nigeria) use this species in the preparation of a remedy for "Maagun," a magical drug that is put on a woman, unknown to herself, so that if she should commit adultery it may cause her lover to fall over three times and die. The effect of "Maguun" on the paramour may assume different forms, e.g. constant coughing, somersaulting, extreme lassitude, haemorrhaging, etc. (105). Also used in the preparation of good luck charms.

Vanderbylia ungulata D.A. Reid — Zambia (142).
Was found being sold at markets in Kitwe (142). Recommended by local herbalists for the treatment of heart trouble: a sizeable piece may be soaked in a cup of water, the patient drinks the liquid, and the fungus is than put on a black thread, to be worn dangling on the chest. Similarly hung from a necklace, a piece may be taken in the

mouth and sucked to alleviate spells of dizziness. Alternatively it is burned, then licked whenever heart problems are experienced. Inhaling the fumes of the smouldering fungus has been prescribed for noose-bleed (142).
In his unpublished records, Fanshawe has reported that probably the same bracket fungus growing on *Pericopsis angolensis* that was smoked in a pipe to cure chest troubles and heart pains (142). The medicinally used *Phellinus rimosus* cited in Watt & Breyer-Brandwijk is, according to Sikombwa & Piearce, a misidentification for *Vanderbylia ungulata* (142). Finally, it should be noted that these authors do not accept that *V. ungulata* is synonymous with *Perenniporia mundula*, a fungus that is also used medicinally in Malawi.

Xylaria papyrifera (Link) Fr. — Central African Republic (62, 63).
Contains a liquid which is used by the Lissongos as treatment of intestinal diseases of children (62, 63). The similarities of the illustrations of this enormous *Xylaria* and some pygmy children given by Heim (62) provide a clear example of the signature theory which explains the use of this mushroom in traditional medicine.

2.3 Miscellaneous ethnomycological uses

2.3.1 Introduction

During our search of the literature on African macrofungi we found some scarce information about ethnomycological uses made of fungi other than food, traditional medicine or mythological practices. Evidence was found for the occasional use of fungi as

- clothing (*Marasmius crinisequi*, *Polyporus rhizomorphus*),
- cosmetic (*Battarrea stevenii*),
- dye (*Podaxis pistillaris*, *Pycnoporus sanguineus*),
- fertilizer? (*Ganoderma colossus*),
- fumigans (*Langermannia wahlbergii*),
- ink (*Coprinus* species),
- luck-bringer (*Ganoderma* sp.).

With the exception of various polypores (see 155), similar information from other continents is probably more scarce and likewise very dispersed in the literature, making general conclusions rather difficult. At least we can say that some of the reported uses are also known from other tropical regions. Possibly, a greater interest of ethnobotanical investigators of fungi can reveal some more data. For instance, it would be interesting to know if the former use of *Fomes* in tinder boxes in Europe is also known in Africa.

2.3.2 Fungi reported having an ethnomycological use other than food, traditional medicine or mythological practices

Battarrea guicciardiniana = ***Battarrea stevenii***

Battarrea stevenii (Libosch.) Fr. — Namibia (157; own determination).
Used by the Topnaar people of the Namib desert. Spores mixed with fat or "!nara"-oil or a ground red stone are used as cosmetic. They also protect the skin from sunburn and drying out (157).

Coprinus species — South Africa (147).
There is a tradition that the black liquid dripping from deliquescing *Coprinus* caps was used as emergency ink by the early settlers from Europe. There are several *Coprinus* species here which can be so used (e.g. *C. comatus*). The "ink" can be obtained by allowing a cap to digest in a cup. This means that the black spores are included and their presence makes the brownish-black writing permanent. The ink also provides safeguard against forgery, as when mixed with ordinary ink, the presence of *Coprinus* spores can be detected by a microscope. *Coprinus* ink will keep well if bottled with a small (5%) quantity of formalin (147).

Ganoderma spec. — Cameroon (own determination).
Kenla (pers. comm.) sent us a photograph of a giant fruitbody of a *Ganoderma* species (84 cm diameter) from near Yaoundé which was considered by the local population as a lucky object. The whole pileus was covered with all kinds of objects varying from jewels to ballpoints and driving licences.

Ganoderma colossus (Fr.) Baker — Senegal (own determination).
Powder made of fruitbodies of this polypore is mixed with seeds before sawing (De Wolf, pers. comm.).

Langermannia wahlbergii (Fr.) Dring — Kenya (34).
According to a forester, dried fungi are used by the natives to fumigate their huts. The fungi are thrown on the fire after which the natives vacate their huts for a time, due to the eye irritation caused by the fumes.

Lasiosphaeria fenzlii = ***Langermannia wahlbergii***

Lentinus tuberregium (Fr.: Fr.) Fr. — Nigeria (161).
Wakefield observed in Ogwashi (Nigeria) that native grind the sclerotia of this species to powder, mix it with dye obtained from *Bixa orellana*, making a paste of the compound with which they painted their bodies.

Marasmius crinisequi F. Muell.: Kalchbr. — Congo (144).
Black rhizomorphs have been and probably still are used to tie jewelry in Congo as well as in East India and Indonesia (144).

Melanopus rhizomorphus = ***Polyporus rhizomorphus***
Microporus rhizomorphus = ***Polyporus rhizomorphus***

Podaxon loandensis = ***Podaxis pistillaris***

Podaxis pistillaris (L.: Pers.) Fr. — Kenya (34).
Common in the Sudan and, according to Massey, used by natives to obtain a yellowish dye for carpets (34).

Polyporus rhizomorphus Mont. — Central African Republic (62), Gabon (24, 25, 60, 62).
The long rhizomorphs of this polypore that were earlier erroneously identified as originating from a *Cordyceps* species (98), are commonly used to plait strings, bracelets and belts (24, 62). Four of the long brilliant filaments are assembled to make a little string with a diameter of about 3 mm and than eight such strings are woven to make a belt which is worn around the waist (24). The microscopic layered structure of the rhizomorph tissue allows a suitable mechanical manipulation of the strings (60).

Pycnoporus sanguineus (L.: Fr.) Murrill — Tropics (165), West Africa (93).
Occasionally used as a dye.

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RÉSUMÉ

La présente revue bibliographique envisage successivement les champignons toxiques et l'ethnomycologie des champignons au sud du Sahara.

La connaissance des champignons toxiques est très fragmentaire et insuffisamment documentée. Néanmoins, quelques rapports indiquent que des cas d'empoisonnement arrivent assez régulièrement, plus spécialement avec des collecteurs inexpérimentés (provenant souvent des régions urbanisées) ou des espèces habituellement rejetées mais consommées en période de famine. De plus, quelques espèces vénéneuses introduites avec des plantations forestières exotiques, telle que *Amanita phalloides* et *A. pantherina*, ont déjà fait honneur à leur mauvaise réputation. Seul un tout petit nombre d'espèces indigènes suspectes ont vu leur toxicité mise en évidence par des expériences, des analyses chimiques ou des déterminations fiables en cas d'empoisonnement. Il est clair que des recherches multidisciplinaires dans ce domaine sont nécessaires pour établir la connaissance des champignons toxiques de cette région.

La littérature sur les champignons comestibles a été déjà revue dans une publication précédente (124), à laquelle nous ajoutons ici quelques corrections et données supplémentaires.

L'usage des macromycètes en médecine traditionnelle en Afrique tropicale et méridionale semble être peu répandu et souvent lié à la mythologie et à la théorie de la "signature". Une analyse chimique n'a été réalisé que pour l'ascomycète *Engleromyces goetzei* permettant dans l'isolation d'une substance antibiotique.

Enfin, quelques rapports mentionnent divers usages traditionnels des champignons tels que la fabrication des ceintures de parure, des colorants, d'un produit cosmétique, etc.

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